PROCESSES AND SIGNATURES OF SEDIMENT SUPPLY, REDISTRIBUTION, AND ACCUMULATION ON AN ACCRETIONARY CONTINENTAL MARGIN

Clark Alexander
Skidaway Institute of Oceanography, 10 Ocean Science Circle, Savannah, GA 31411
Phone: 912-598-2329 Fax: 912-598-2310 Email: clark@skio.peachnet.edu
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LONG-TERM GOALS

The long-term goal of this project is to determine what sedimentary processes are important in the formation and development of the continental margin in an accretionary system. To this end, I am examining the rates and geologic signatures of sedimentary processes which produce redistribution and accumulation of shelf and slope sediment. Thus, this project is measuring the rates of sediment accumulation and is examining the preserved record of these processes in the sediment column.

SCIENTIFIC OBJECTIVES

The focus of this project is document the important sedimentary processes on the continental slope (i.e., sediment accumulation, erosion, and redistribution) and how these processes are recorded in the sedimentary strata of continental margins. The specific objectives of this project are:

- to determine the rates of sedimentary processes on 1-yr, 100-yr and 1000-yr timescales.
- to use short-lived radiochemical tracers for the documentation of slope sediment delivery.
- to determine the role of slope gullies in sediment dispersal.
- to perform a detailed stratigraphic analysis of preserved event bed stratification in slope deposits.
- to delineate the Eel River dispersal system and calculate a sediment budget for the slope.

APPROACH

These objectives are being achieved through seabed sampling on a variety of temporal and length scales. Sediment cores (0.5-9 m in length) are being collected to investigate processes that dominate on 1-1000 year time-scales. Work has been focused on completing analyses of a large suite of cores, collected during the past year, and in collecting additional cores in unsampled regions that are critical to achieving the goals outlined above. Rates of processes are being examined using a suite of radiotracers pertinent to the timescales involved (^{7}Be, ^{234}Th, ^{210}Pb, and ^{14}C). Examination of sedimentary properties in longer cores and over longer timescales will be used to provide a more thorough understanding of those processes that leave their signature in the geologic record.

WORK COMPLETED

Numerous field sampling efforts have been carried out beginning with an Eel River flood rapid-response cruise in January 1997. This cruise was focused on determining the distribution of flood-derived material on the shelf and slope as evidenced by the presence of ^{7}Be in seabed sediments. Detectors were calibrated for ^{7}Be prior to the cruise using funds provided by this project. A second cruise in July focused on providing ground truth and age control for geophysical observations by collecting piston cores positioned prior to the cruise in consultation with STRATAFORM geophysicists. Additional cores were collected to finalize the sediment budget, and to investigate canyon-head sedimentary processes in the Eel Canyon. In August, a third cruise occurred with Dan Orange (MBARI) on which nine 1-m long cores were collected using the MBARI ROV *Ventana*. Cores were collected inside and outside of gullies, pockmarks, and tectonic features to characterize sedimentary processes in these depositional environments. Cores were also collected in the Eel Canyon to quantify the importance of modern down-canyon sediment dispersal. Video of the bottom documented the morphology of the slope.

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Because most cruises took place near the end of the fiscal year, many of the goals of this research are in the process of being achieved. The long piston cores collected during this project are presently being subsampled for ^{14}C analyses to provide long-term accumulation rates and for textural analyses and stratigraphy to provide ground-truth data for seismic interpretations. Selected beds are being examined by thin-section microstratigraphy to determine mode of emplacement.

RESULTS

Cores collected after the January 1997 flood demonstrate that fine-grained, flood-derived material reached the slope rapidly and created a deposit up to 4 cm thick. ^{7}Be and green leafy debris were observed in surficial sediments seaward, but not northward, of the river mouth out to 450 m water depth, indicating that material can reach all regions of the slope over time. Previous work had suggested that only the northern portion of the slope was receiving sediment actively.

A suite of 112 cores has been collected to examine the processes of sediment accumulation, biological sediment mixing, and sediment delivery to the Eel River continental slope. Spatial surveys of accumulation rate (0.2-0.6 g/cm^2y), surficial sediment grain size (4-8.5), biological mixing rates (5-61 cm^2y) and ^{234}Th inventories demonstrate that sediment is accumulating throughout the Eel River margin, reflecting a rapid and widespread redistribution of the Eel River's discharge. Downcore grain size profiles of heterogeneous sediments suggest that hemipelagic and periodic downslope sediment delivery processes may be important to sediment delivery to the slope in areas proximal to the river. In areas more distal to the river, downcore profiles reveal relatively homogeneous sediments, suggesting delivery by hemipelagic processes. At present, the sediment budget shows that the slope contains 20% of the river's annual discharge; a combined budget for the shelf and slope documents that 60% of the annual sediment load is not accounted for in these areas.

IMPACT/APPLICATIONS

Results of this project demonstrate that processes typically associated with sea-level low stands (i.e., direct supply of sediment to the slope and turbidite generation and accumulation) are actively occurring on the Eel River margin. The distribution of accumulation rates across the slope suggests that the slope is building up along the shelf break, where sediment is then remobilized and transported to the lower slope, by-passing the mid-slope. Over the long term, such a redistribution will lead to a shallowing of the slope profile and a change from a concave down to a concave up profile.

TRANSITIONS

Data on the distribution of ^{7}Be in slope sediments is being used by the shelf research group to quantify the flux of flood material from the river to the margin. Accumulation rate data on 100-y timescales are being used by geotechnical and geophysical research groups to better interpret their own observations.

RELATED PROJECTS

Lee (USGS) and I have been working closely for the past three years, and will continue in our collaboration on the relationship between sedimentary processes and geotechnical properties. Nittrouer (SUNY) and I are cooperating closely to quantify flood sedimentation patterns and long-term sediment accumulation rates and to develop a sediment budget for the shelf and slope. Information concerning the rates and modes of sediment supply and redistribution within the slope region, as will be provided by accumulation rate, sediment micro-structure and textural observations, are critical for ground-truthing Field and Gardner's (USGS) geophysical surveys and as input to Pratson's modeling efforts and Orange's tectonic studies.

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